Assessment of External Supports for Harvesting Artisanal Galda (*Macrobrachium Rosenbergii* de Man) Fisheries from the Sundarbans Mangrove Ecosystem in Bangladesh

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Citation Reference:

Shaha, B.K., Alam, M.M., Islam, H.M.R., Alam, L., and Mokhtar, M. 2015. Assessment of External Supports for Harvesting Artisanal Galda (*Macrobrachium rosenbergii* de Man) Fisheries from the Sundarbans Mangrove Ecosystem in Bangladesh. *International Journal of Lakes and Rivers*. Vol.8(1), pp. 1-23. [[Online Link](#)]

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Abstract

The study was conducted through 24 individual surveys in the SME of Bangladesh covering 16 river/canals and 32 locations (one-third area) of the Sundarbans by direct interviews of randomly selected 1,989 fishermen from 545 non-mechanized boats and 1,428 active gears from eight types of gear. The source of credit, agreement of *Dadan*, variability in prices, profit distribution agreement between boat/gear owner and the fishing labour, catch volume, and the relation between the fisher and the landing centers (i.e., intimacy and expected market prices) were found to be determinant factors in determining the place for landings of the harvested catches in the study area. There was access of fishers to the formal credit markets (i.e. scheduled banks or cooperatives) at 13 ± 2.83 (11-15) % interest. However, the rate of interest offered by the NGOs was significantly higher (mean: 45 ± 31 , range: 18-76%) than the bank rates. A number of formalities were found to inhibit fishers to receive credit from Banks and NGOs. About 60-100% of the value of *Galda* catch, after covering the operational costs, was taken by the boat and gear owner. The share of the labor also varied by the type of work performed (catching, drying, transporting, cooking on boat etc.). The average prices of *Galda* at landing centers are varied from BDT 290 to 750 kg⁻¹. The average prices of *Galda* at landing centers and in international markets were BDT 290 and 750 kg⁻¹, respectively in 2006. The Department of Forest, being the legal authority in the management of aquatic resources inside the waters of the SME of Bangladesh should care the sustainable management of small-scale fisheries to ensure a sustainable growth rate of *Galda*, and protect over exploitation. Proper and easy financial and credit supports is needed for the economic betterment of the small fishers. Hence the findings and the recommendations of this study is supposed to be helpful for policy makers in improving the current status of *Galda* fishery and relevant human livelihood as well as conserving the Sundarbans Mangrove Ecosystem ecosystem.

Key word: Macrobrachium rosenbergii; Sundarbans Mangrove Ecosystem; Microcredit; Fish Market

Introduction

The revereie giant prawn *Macrobrachium rosenbergii*, locally called as *Galda*, is one of the high valued crustaceans in Bangladesh and also a highly valued product in international markets; almost all prawns are therefore exported, particularly to the USA, Japan, and Europe. Traditionally, freshwater prawns have been caught wild in ponds and marshes (Gain, 1998) through artisanal fisheries across the country. It has been widely distributed in all types of freshwater habitats and also migrates to the costal saline estuaries for breeding.

The species is cultivated across Bangladesh in freshwater ponds for export. Between the late 1970s and the mid-1980s, a few pioneering farmers in Fakirhat *Upazila* (sub-district) in Bagerhat *district* developed Galda farming technology in small rice-fields using mainly rain water and peripheral mud embankments (Rutherford, 1994). In 1976 Bangladesh exported a total of 3,800 mt of shrimps and prawns, and in just twenty years this grew

eightfold to 31,500 mt. Of this total, approximately 85% were cultured, half of them are from fresh water. These exports earned 248 million dollars, equivalent roughly to a 3% share of the world's total shrimp/prawn exports (Vannuccini, 1999). Bangladesh exported 46,533 mt of prawn and shrimp in 2005 valued at US\$ 378 million in which 25–30% was contributed by prawn (DoF, 2006). This figure is expected to rise with the increasing expansion of freshwater prawn cultivation into new area of Mymensingh district in the north-central part of Bangladesh (Ahmed et al., 2008). The total area under cultivation nationwide is estimated to be around 30,000 ha (Williams, 2003). Assuming that the royalty rate is only 12.5% of the gross value of the products, it can be calculated that the gross value of the fish products in 1990-91 was BDT 112 million (US\$ 2.8 million) (Islam, 2007).

The Sundarbans, a cluster of islands with an approximate area of 10,000 square kilometers in Bangladesh and India, is the largest mangrove forest in the world (Rahman et al., 2003). It is located at the southern extremity of the Ganges delta bordering the Bay of Bengal along the southwest of Bangladesh and southeast of India. About 60% of the Sundarbans are within Bangladesh territory, known as the Sundarbans Reserved Forest (SRF) or Sundarbans Mangrove Ecosystem (SME), is located at the southwest part adjacent to the district of Bagerhat, Khulna and Satkhira. Ecologically the SRF is classified in to three ecological zones- i) freshwater zone along the Eastern part within Sarankhola range; ii) moderately saline zone along the middle-southern part within Khulna range and iii) high saline zone along the south-western part within Satkhira range (Karim, 1994). Mangrove ecosystems act as nursery grounds and provide refuges for many species of fish, crustacean and mollusks (Ronnback, 2001; Ronnback, 1999). There is a positive correlation between mangrove area and shrimp/fish catches (Primavera, 1995 and 1997). It has been estimated that every hectare of mangrove generates upwards of 450 kg ha⁻¹ of marine catch (WB, 2006). The continued existence and functionality of the Sunderbans mangrove forest is of critical importance to the entire marine fishery of the Bay of Bengal. An estimated 80% of the Indian fish catch from the Ganges and Brahmaputra river deltas originates in the Sundarbans mangroves (Hinrichsen, 1998), while others estimate that perhaps as much as 90% of commercial fish catches in the Bay of Bengal rely on Bangladesh's Sundarbans Reserved Forest as a nursery area (Rouf and Jensen, 2001). About 20% of Bangladesh's coastal communities rely exclusively on wild fisheries for their income (Barkat and Roy, 2001). About BDT 30 million (US\$ 750,000) per annum is earned from 60 million kg of shrimps, mainly tiger prawns, from the Sundarbans and other coastal mangrove areas of Bangladesh (DoF, 2005; BBS, 2005).

A large number of fishing community is involved in *Galda* fishing from the SME. An average of 67,195 boats with 165,270 fishermen annually visits the Sundarbans and fish for their livelihood (DoF, 2008a). Recent data reveals that the collection of "seed" prawns involves about 25,000 men, women and children (DoF, 2008b). Shell collection also contributes to the employment of young boys and girls (about 550 permit issues each engaging 3-4 people each year). The number of shell collectors increases during the winter tourist season (Rahman et al., 2003; Giasuddin, 2002). While there is great potential for increasing family incomes through engaging in prawn cultivation, a number of factors might contribute to the vulnerability of prawn farmers including increased production costs, poor institutional support, and inadequate extension services (Ahmed, 2002); on the other hand, those factors are less effective in wild fishery. With this view, it is essential to understand the external facilities available for harvesting *Galda* from SME.

However, no information is available on the *Galda* fishery in particular in the above context in the SME. This study, therefore, was aimed at to assess the available marketing and financial supports for *Galda* (*Macrobrachium rosenbergii*) fishery from the Sundarbans mangrove ecosystem of Bangladesh. The findings will benefit fishers, researcher and policymakers.

Literature Review

The existing literature on aquatic species in Bangladesh are by large focused on the farming aspects rather than fishery (Halim *et al.*, 2001; Ling *et al.*, 1999; Huda *et al.*, 2002; Aftabuzzaman, 1998; Thomas *et al.*, 2001; Bhattacharya *et al.*, 1999a and 1999b; Leung and Sharma, 2001; Ling *et al.*, 2001; Shang *et al.*, 2001). Most of the economic analyses carried out in the past in Bangladesh were concentrated on aquaculture production of *Galda* or *Bagda* shrimps (Shah *et al.*, 2000; Ito, 2002; Ahmed *et al.*, 2008; Alam *et al.*, 2007; Ahmed, 2001; UNEP, 1999; BCAS, 2001; Quddus *et al.*, 2001; Manju, 1996). Exploration of the Sundarban mangroves dates back to the 16th century (Rollet, 1981), a large bulk of published literature exists on the Sundarbans of both India (Naskar and Guha Bakshi, 1987; Chaudhuri and Choudhury, 1994; Guha Bakshi *et al.*, 1999) and Bangladesh (Seidensticker *et al.*, 1991; Hussain and Acharya, 1994; Islam and Wahab, 2005) covering many aspects of their habitat characteristics, flora, fauna (particularly fisheries), utilization and management. However, little is known about the functional aspects of this ecosystem.

Alam (2001) described three different levels of fish markets including *Galda* marketing. A detailed description of *Galda* marketing is available in Tsai and Ali (1997). Rutherford (1994) outlined the marketing structure of the freshwater prawn industry, together with the financial flows with five layers of agency. At the top are fish-processing and export companies located in Khulna town. Below them are the commission agents who buy prawns from local middlemen (*Depot Maliks*) and sell them on to the companies for a commission: many of these commission agents are wealthy businessmen in Khulna who have easy access to bank loans. The third layer is composed of the *Depot Maliks* (storage-owners-cum-fish-buyers) themselves, who purchase prawns from local producers and sell them on to commission agents. It is impossible to miss their presence, since this is registered in almost all the local prawnfarming markets in Bagerhat and Khulna by the large signboards of the individual *Depot Maliks* bearing huge, garish pictures of prawns and shrimps. They often buy prawns directly from prawn farmers, but there are also local small traders called *Forias* who mediate between local farmers and *Depot Maliks* (Ito, 2002).

Although there are several internationally recognized grading system (counts/lb) for *Galda* marketing (FAO, 2004), it is absent in the primary markets at local levels mainly due to poor bargaining power of the fishers unlike mud crab prices (Zafar and Ahsan, 2006). Moreover, there is a little variation in selling prices due to transport costs and available marketing facilities. Locally all *Galda* catches from the SME are marketed at fresh condition. Quality maintenance facilities (ice or other processing facilities) in the SME are very poor. There is high risk of spoilage of the harvested catch if collector boats respond late. There is also a lack of knowledge about sound post-harvest practices (Zafar and Ahsan, 2006).

Like other fisheries product, *Galda* trading is characterized by several categories of fishermen and fishing enterprises with the share arrangement regime (Dastidar, 2001; Hussain *et al.*, 1995; Coulter and Disney, 1987). There have a strong relationship between market demand for *Galda* and the supply of credit. There is a separate distribution channels

for *Galda* marketing. Dastidar, (2001), Hussain *et al.*, (1995) and Zafar and Ahsan, (2006) mentioned that mud crab and shrimp trading, other than fish, in the region has increasing consistently over the past few years, only due to higher demand for *Galda* in the international markets. European-union, Malaysia, Japan, USA and Singapore are the main markets for frozen Bangladeshi *Galda*. There seems to be significant fluctuation in the market prices of *Galda* due to the wide seasonal variations in the landings volume and seasonal demand by the export markets (Hill, 1984).

Bostock *et al.*, (2004) also mentioned that the owners of small mechanized *Galda* fishing boats in Bangladesh do not have enough money to finance their journey to the sea. They have to borrow money from the moneylenders and the loan system is the same as the cultured shrimp production system. When these boats land on the shore the boat owners had to sell shrimps to their respective moneylenders or local traders at lower prices to compensate the interest on the borrowed money. The traders then sell the shrimps to the processing factories. The processing factories sell frozen shrimp of various categories sell out their products to the foreign buyers through brokers. Sometimes shrimps are supplied to the factories by depot owners. The moneylenders sell shrimp to the depots which is eventually supplied to the processing factories through local Foria (brokers).

Unlike other inland closed fishing communities, coastal seas and tidal rivers constitute the key traditional livelihoods assets and the main sources of financial capital to the coastal fishing communities throughout the access to informal and the quasi-formal credit markets (Ulrich *et al.*, 2003; PDO-ICZMP, 2003b; CDSP-II, 2000). The main form of loan is the *Dadan*. *Dadan* provider is the key player (i.e. fish trader cum money-lender) in controlling fishing effort and marketing of harvested *Galda* from the SME area. Other actors of the informal credit markets are the crab depots, fish depots and moneylenders, while the NGOs are considered as the actors of quasi-formal credit market (Ulrich *et al.*, 2003; Hannan, 1996).

Fishers' access to the formal credit market (i.e. scheduled banks) is virtually limited due to their lack of tangible assets, although bank rate is lower than other informal markets. The rate of credit from moneylenders is sometime even lower in areas of strong supply of micro-credits from the NGOs. However, interest rate of micro-credits is also higher (75-200%) than the bank rate (BBS, 1999; Islam, 2002; Grameen Bank, 2001; Ulrich *et al.*, 2003). Alam (2001) reported that more than 500 NGOs were involved in aquaculture and fisheries in Bangladesh targeting over 250,000 households. However, while most NGO programs focus on aquaculture demonstration and training for the poorest segments of rural society, small-scale fishermen find difficulty in obtaining credit facilities. Nandeeshha and Alam (2001) reported that about 800 CARE staffs were involved in extending aquaculture activities among 40,000 targeted households of which 20-30% were involved mostly in mostly rice-fish culture.

As traders are powerful in both market control and socially, browbeaten fishermen through weak loan arrangements with traders actually reflect inefficiencies of the credit system rather than marketing system. Fishing season also affect the demand for wage labor and obviously access to credit. For example, before the start of the main fishing season they need a special attention to face financial crises during off-season generally from May to August (Hannan, 1996). But in the present study, the main fishing season was found during monsoon months from June to September?

Data and Methodology

This study was conducted through several field surveys in the SME waters covering three administrative ranges (Figure 1). The SME is located between longitudes 89°00' E and 89°55' E and latitudes 21°30' N and 22°30' N at the south-west of Bangladesh, encompassing mouth of the 6 estuaries, and numerous rivers, canals and creeks (Giri and Shrestha, 1996; Viju, 1995).

Figure 1: Map of Sundarbans where Range Headquarters are study areas

The study was conducted through 24 individual surveys in the SME of Bangladesh covering 16 river/canals and 32 locations (one-third area) of the Sundarbans along the Mongla-Passure-Dubla area within Sharankhola, Chandpai and Khulna ranges between January and December 2006 at fortnightly interval (Table 1).

Table 1: The GPS locations of the survey areas in the SME

N Latitude	E Longitude	N Latitude	E Longitude
21°17'08.8"	89°34'22.6"	21°55'090"	89°33'897"
21°17'11.6"	89°38'52.0"	21°56'44.4"	89°34'59.5"
21°44'78.4"	89°33'27.6"	22°14'90.7"	89°36'32.4"

21°45'15.0"	89°32'51.8"	22°37'11.6"	89°29'96.7"
21°46'09.8"	89°32'52.2"		

The data were collected by direct interviews of randomly selected 1,989 fishermen from 545 non-mechanized boats and 1,428 active gears from eight types of gear. The data were analyzed through descriptive statistics (mean, range, standard deviation) by using SPSS software. The monthly variation in abundance of *Galda* was estimated by using one-way ANOVA.

Records of Harvesting *Galda* Fish from SME

The productions of *Galda* from the artisanal fishery inside the SME are recorded by the Department of Forest (DoF), Bangladesh. Total SME annual production showed marked variation between years, being the highest (290,431.60 kg) in 2001 and the lowest (110,515 kg) in 2002 (Figure 2). After 2002, the production increased steadily up to 2004. Among the four administrative ranges, the mean yearly production volumes from Khulna range were significantly higher ($105,360 \pm 59,419$ kg/yr) than Satkhira ($44,165 \pm 18,548$), Chandpai ($22,532 \pm 6,593$) or Sharankhola ($21,910 \pm 7,364$). Figure 3 indicates a significant effect of geographic location on production of *Galda* in the SME. However, there were marked variation in number of fishing gears, boats and fishers among the ranges.

Figure 2: The annual production (kg/yr) of *Galda* from the SME
Source: compilation from DoF 2005, 2006, 2008a, 2008b

Figure 3: Mean yearly production (kg/yr) of *Galda* from Four administrative ranges of the SME

Source: compilation from DoF 2005, 2006, 2008a, 2008b

Among different months, the highest production (296478 ± 10675 kg) was recorded in January and the lowest in July (59750 ± 4413 kg). After January, the production rate declined steadily until May and thereafter started to increase gradually with a sudden fall in July (recognized as lowest production month). This trend suggests that Dry summer and monsoon seasons are not suitable for good catch of *Galda* in the SME (Table 2).

Table 2: Mean (± 1 SD) monthly *Galda* production in the SME during the year 2000-2004

Months	Mean Production (Kg)	Months	Mean Production (Kg)
January	296478 ± 10675	July	59750 ± 4413
February	246650 ± 17418	August	78429 ± 4084
March	117194 ± 7569	September	125916 ± 7807
April	103229 ± 3836	October	114503 ± 4476
May	83519 ± 4703	November	122140 ± 4641
June	95981 ± 5724	December	129928 ± 7735

Source: compilation from DoF 2005, 2006, 2008a, 2008b

Although the highest number of fishers (21807) was engaged in fishing in 2000 (Table 3), but the highest production volume was registered for 2001 (Table 4). Comparatively higher numbers of fishers were entered in the Satkhira range (2546 to 7734) than the (Khulna range (4170 to 7063), Sharankhola range (2854 to 3893) and Chandpai range (2412 to 3160) (Table 3). The production data were also compared by geographical locations remarked by administrative ranges. It reveals that Khulna range was the best for higher *Galda* landings (105360 ± 59419 kg) in comparison to Satkhira (44165 ± 18548), Chadpai (22532 ± 6593) and Sharankhola (21910 ± 7364) range.

Table 3: Water area and the number of fisher in four administrative ranges of the SME during 2000-2004

Year/Range	Sharankhola	Chandpai	Khulna	Satkhira	Total
Water area (ha)	39299	30006	48404	55498	173207
2000	3850	3160	7063	7734	21807
2001	3684	3138	5850	5704	18376
2002	3893	3023	5771	5321	18007
2003	3017	2617	5271	3405	14309
2004	2854	2412	4170	2546	11982
Mean $\pm$ SD	3459.6 ± 488.17	2870 ± 336.57	5625 ± 1046.68	4942 ± 2038.55	16896.2 ± 3820.43

Source: compilation from DoF 2005, 2006, 2008a, 2008b

The monthly and daily harvest volume (CPUE) of *Galda* shrimp from the SME recorded by the Department of Forest between 2000 and 2004 from four administrative ranges are presented in Table 4. The highest mean monthly harvest was recorded from Satkhira range at $16,939 \pm 11734$ kg in 2000, while the minimum harvest was recorded at

883±3060 kg from the Chandpai range. The daily CPUE (kg/day) was found to be the highest at 1210±838 kg in the Satkhira range in 2000, followed by 1082±750 kg in 2002 from the same range. Both the monthly and daily CPUE were significantly varied among the ranges between 2000 and 2004.

Table 4: The monthly landings and daily CPUE (kg) of *Galda* harvest from the SME during 2000-2004

Year	Sharankhola	Chandpai	Khulna	Satkhira
<i>Harvest volume in kg (Mean±SD)</i>				
2000	5288±6337	883±3060	9320±4803	16939±11734
2001	3978±5954	1480±1556	6368±3503	12461±10326
2002	4993±8162	7367±7305	4988±3449	15155±10497
2003	2327±3842	4937±5304	4227±2358	7101±4508
2004	3136±3517	4552±5556	10050±20055	5592±4973
<i>Daily CPUE in kg (Mean±SD)</i>				
2000	378±453	63±473	666±343	1210±838
2001	284±425	106±110	455±250	890±738
2002	357±583	526±522	356±246	1082±750
2003	166±274	353±379	302±168	507±322
2004	244±251	355±397	783±1432	436±355

Source: compilation from DoF 2005, 2006, 2008a, 2008b

The abundance of *Galda* (kg/ha) has been estimated from DoF landing data it was the highest 1.5375±1.7 kg/ha in 2001 and the lowest 0.61±0.34 kg/ha in 2002 (Figure 4). There was a significant variation in mean abundance of *Galda* between the ranges, being the highest in Khulna (2.176±1.23 kg/ha) and the lowest in Sharankhola (0.56±0.19 kg/ha) range (Figure 4).

Figure 4: Yearly variation (S.D.) in mean abundance of *Galda* (kg/ha) in the SME
Source: compilation from DoF 2005, 2006, 2008a, 2008b

Figure 5: Geographic variation (S.D.) in mean abundance (kg/ha) of *Galda* in the SME

Source: compilation from DoF 2005, 2006, 2008a, 2008b

The monthly variation in abundance of *Galda* (kg/ha) has been estimated from DoF landing data. The abundance of *Galda* varied significantly ($P < 0.05$) among the months, being the highest in January (0.34 ± 0.26 kg/ha) and the lowest in July (0.06 ± 0.08 kg/ha) (Figure 6). The mean monthly abundance of *Galda* was the highest in January and fell gradually until July. After July it started to increase until December.

Figure 6: Variation in mean monthly abundance of *Galda* (kg/ha) in the SME

Source: compilation from DoF 2005, 2006, 2008a, 2008b

Structure of Local Market for Selling *Galda* Fish

The marketing chain of *M. rosenbergii* caught from the SME is similar to the existing fish marketing channel in the southwest region of Bangladesh. Trading of *Galda* in the region has been boosted up in recent to meet growing international market demand. As a consequent, the production from aquaculture farm and harvest from natural sources including the SME have been increased steadily over the past few years.

Several categories of fishermen and fish catching enterprises have been identified, namely, (i) fishing labour who work on other's boats only during fishing trip; (ii) fishers with their own boats; (iii) fisher use other's boats in fishing under catch-share agreement with boat owners; and (iv) employed fishers who receive fixed salary from the boat owners. For the 3rd category, boat owners receive the lion share (50-60%) of the catch. Employed fishers usually receive a wage at BDT 50–100 day⁻¹ plus daily meals during fishing on boat. The boat owners may not join in fishing, but can sell the entire catch himself and keep the whole revenues.

The income-sharing arrangement between boat owner and crews varies from area to area. The conditions i.e., covering of operational costs, share distribution according to crew's function etc. observed in the present study agrees well with the findings of [Rahman \(1993\)](#). Crew's functional service also includes catching, drying, transporting and support services, such as cooking. Present study also found that the strong involvement of head fisher, assistant head fisher and laborers with fishing than the boat owners and other fishers, such as cooks, helpers, net makers, repairers. The boat owners' second most important job is business, while other fishers are involved with different occupations for varying periods.

[Hussain et al., \(1995\)](#) reported that boat owner obtains the biggest portion of the catch (~50–60%), whilst the crew obtains the remainder. In the present study 40-60% share is occupied by the boat owners and crews receive salary plus meals paid (BDT 50–100 day⁻¹) and a part as a bonus depending on the amount of fish caught calculated using an agreed formula. Fishermen-dadandar-aratdar-trader-paikers-dalal-faria-beparies-processing plant authority relationships ([Dastidar, 2001](#); [Hussain et al., 1995](#); [Coulter and Disney, 1987](#); [Hill, 1984](#); [Hussain et al., 1995](#)) have exerted a propensity to sell catches at the landing centers ([CODEC, 1994](#); [Zafar and Ahsan, 2006](#)). Similar trend has been found in the present study.

Conventionally, a *Dadan* (advance loan) borrower is bound to sell his catch to his *Dadandar* (advance loan payer) at prices lower than market prices. *Dadondars* form the primary market at landing centers. They also play as intermediary traders to sell their purchased goods to the secondary markets. They actually play the role of assemblers at the landing centers (primary markets). They also preformed as the wholesalers who trade goods between secondary and higher secondary markets (i.e. wholesale markets) of the country. In general, *paikers* (wholesaler) are tied to a limited number of *Aratdars* (warehouse owner) who provide them loans as working capital. If they have *Dadan* from an *Aratdar*, they have to sell/buy their fish through/from him, using him as a commission agent who usually gets 3-6% commission for his services and costs involved. Part of the commission (2-3%) may represent an informal form of interest charged by the *Aratdars*. Moreover, *Aratdars* play several brokerage functions at the same time. This includes commission agent mentioned above or wholesaler whereby they become the buyer and seller of the commodity (Figure 7).

Figure 7: Actors in marketing of *Galda* in the SME in Bangladesh

Financial Supports for Small *Galda* Fishers

The artisanal fishery in the Sundarbans is largely dependent on the supply of credits from various sources. Credits are mainly used to cover purchasing/repairing fishing unit and food costs for the both fishers during a fishing trip and their families at home. The volume of credit received by the fishers varied from BDT 400 to 45,500. However, most of the fisher (36.28%) had a credit limit between BDT 1,000 and 5,000. Only 3.23% fishers' had a comparatively larger volume of credit ranged between BDT 10,000 and 15,000 (Table 5).

Table 5: Volume of credit received by the *Galda* fishers in the SME

Credit range (BDT)	% of credit holder (fishermen)
<1000	33
1000-5,000	36.28
5000-10000	20.9
10000-15000	3.23
Above 15000	6.59
Total	100

Source: Primary survey 2006

Three types of credits markets, namely- formal, informal and the quasi-formal were found to exist as the source of credit supply to the fishers for operating artisanal fishery in the SME (Table 6). Informal sources were found to be the key players in supplying credits to *Galda* fishers. Institutions that lend credit or *Danon* to *Galda* fishing community included were banks (formal source), NGOs (the quasi-formal source), *Dadondar*, fish traders and suppliers (fish trader), and broker (*Foria*, i.e., middlemen in various forms). Among different money lenders, the fish trader-cum-money lender was found to be the key traditional actor for in supplying credit for most of the fishing operations inside the SME. The volume of *Dadan* depends on economic condition of the fishers and the gear used. The highest 58.63% fishers received credits from *Dadondars*. A larger part of the fishers (23.08%) collected credits from family enterprise. About 9.19% fishers receive credit from local money lenders (other than fish traders). Only 7.8% and 1.3% fishers received credits from the NGOs and the banks, respectively (Table 6). The conditions for credit were varied by volume and location. Generally a *Dadan* borrower is obliged to sell his catch to the *Dadandar* at 20-40% lower prices than actual market prices which can be considered as informal interest. Most of the money lending organizations was located in the fish trading centers at close proximity of the

SME. The major *Galda* trading centers were found at Munshiganj of Satkhira; Rupsh fish market, Nutan Bazar fish market, Koyra and Paikgacha of Khulna; and Mongla, Rampal, Digraj and Soronkhola of Bagerhat district.

Table 6: Credit and suppliers interest rate for the *Galda* fishers in the SME

Source	% of credit burrowers	Interest rate (%)		Location
		Mean $\pm$ SD (Min.-Max.)	Duration (months)	
Bank (SME section)	1.3	13 $\pm$ 2.83 (11-15)	12	1. Khulna, 2. Bagerhat and 3. Satkhira
Local money lender (other than fish traders)	9.19	86 $\pm$ 23 (70-120)	6-12	1. Khulna: Rupsha Fish Market, Rupsha Natunbazar and Koira. 2. Satkhira 3. Bagerhat: Mongla, Soronkhola 4. Pirojpur
Faria and other middlemen	6.9	32 $\pm$ 10 (19-42)	Fishing Season	1. Khulna: Koira; 2. Bagerhat: Holdibunia, Mongla, Digraj, Rampal 3. Satkhira
Multi depot (fish/crab/shrimp or <i>Galda</i>)	7.2	42 $\pm$ 17 (25-65)	Fishing Season/1-12	1. Bagerhat: Mongla, Digraj,
NGO	7.8	45 $\pm$ 31 (18-76)	6-12	1. Bagerhat: Mongla, Digraj, Joimuni and 2. Khulna
Crab depot	12.03	40 $\pm$ 15 (24-55)	Fishing Season/1-12	1. Khulna: Koira 2. Bagerhat: Holdibunia, Mongla, Digraj, Rampal 3. Satkhira
Fish depot	13.2	40 $\pm$ 15 (24-55)	Fishing Season/1-12	1. Khulna: Rupsha Fish Market, Koira 2. Bagerhat: Mongla, Bagerhat, Joimuni
Shrimp/ <i>Galda</i> depot	19.3	40 $\pm$ 15 (24-55)	Fishing Season/1-12	1. Khulna: Rupsha Fish Market, Rupsha Natunbazar, Koira; 2. Bagerhat: Mongla, Joimuni
Own (no loan; family enterprise)	23.08	0		1. Family Enterprise
Total/ average	100	42.11 $\pm$ 20 (11-120)		

There was access of fishers to the formal credit markets (i.e. scheduled banks or cooperatives) at 13 $\pm$ 2.83 (11-15)% interest. However, the rate of interest offered by the NGOs significant higher (mean: 45 $\pm$ 31, range: 18-76%) than the bank rates. In some remote rural areas, where the number of NGOs are fewer, they charge interest rate as maximum at 47-150%. While, *Faria* and local money lenders supply credit at comparatively lower rates (32 $\pm$ 10, 19-42%) after the formal banks. Trading centers that dealing single species (shrimp, crab, fish or *Galda*) offere an interest rate of 42 $\pm$ 17 (25-65) % while multi-species trading centers offered a comparatively lower rates (40 $\pm$ 15, 55-24%. A number of formalities were found to inhibit fishers to receive credit from Banks and NGOs. For instance, banks and NGOs have a strict time period (6-12 months) to return credit with interest which is absence of in the informal credit markets. Comparatively longer processing time (1-6 months) in issuing credit by the formal sources was found another vital factor that also inhibits fishers to receive credits from these sources.

It is also evident from the present study that the ‘exploitation’ of fishers was mainly due to the weak loan agreements between the fishers and traders. This indicates the inefficiency of credit system rather than marketing system. However, credit conditions were more favorable to the fishers in the areas closer to the fishing locations than the distant areas. In absence of formal credit sources, there is an informal profit-sharing arrangement in the fishery which varies from area, the type of fishery and the fishing season. For instance, 60-100% of the value of *Galda* catch, after covering the operational costs, was taken by the boat and gear owner (100% if hired crews are paid by cash). The remaining part (<40%) was distributed among the hired fishing labors. The share of the labor also varied by the type of work performed (catching, drying, transporting, cooking on boat etc.).

Market Supports for Small *Galda* Fishers

Most of the fishers tend to sell their catch to the collector boats at fishing place within the SME area or at the landing centers. The source of credit, agreement of *Dadan*, variability in prices, profit distribution agreement between boat/gear owner and the fishing labour, catch volume, and the relation between the fisher and the landing centers (i.e., intimacy and expected market prices) were found to be determinant factors in determining the place for landings of the harvested catches in the study area. About 55% of the respondent fishers sold their catch at Notun bazar of Khulna district. The rest of the respondents landed their catches equally (18.18%) at Digraj, Mongla of Bagerhat district and Rupsha wholesale market, Khulna. Only a few fishers (9.09%) landed their catches at Joimuni of Bagerhat district.

Although there is international grading system in *Galda* marketing chain, it was found to vary by location and the level of marketing chain. The *wholesaler/Aratder* purchase *Galda* from the supplier or lower intermediaries at different rate or at a common rate but sold at higher rate or grade to the exporters/export suppliers. Generally fishermen sell out their harvested *Galda* to the local traders at size-weight basis. About 50% of the harvest were sold at grade 20, <10% at grade 5 or 10. The remaining *Galda* were equally divided between grades 30 and 50. The average landing center price of *Galda* depends on grade which varied from US\$ 2.6 to 6.5 kg⁻¹ (Table 7). The international grading and selling prices are presented in the Table 8. The average prices of *Galda* at landing centers are varied from BDT 290 to 750 kg⁻¹. The average prices of *Galda* at landing centers and in international markets were BDT 290 and 750 kg⁻¹, respectively in 2006.

Table 7: Prices of head-on *Galda* landing center at Southwest region of Bangladesh

Grade	Counts (No. of head-on <i>Galda</i> kg ⁻¹)	Average weight (g)	Price (BDT kg ⁻¹)			Average prices (US\$ kg ⁻¹)
			Maximum	Minimum	Average prices (BDT kg ⁻¹)	
5	5 or less	200	430.50	414.50	422.50	6.50
10	6–10	125	351.50	337.50	344.50	5.30
20	11–20	70	287.00	272.00	279.50	4.30
30	21–30	40	239.00	229.00	234.00	3.60
50	31–50	25	171.00	167.00	169.00	2.60

1 US\$= BDT 65.00

Table 8: Prices of headless *Galda* at processing factories in the Southwest region of Bangladesh

Grade	Count (no/lb)	Average prices at			
		Processing factory (BDT lb ⁻¹)	International market (BDT kg ⁻¹)	Processing factory US\$ lb ⁻¹	Processing factory (US\$ kg ⁻¹)
U-5	>5	455.00	1001.00	7.00	15.40
5/7	5–7	422.50	929.50	6.50	14.30
8/12	8–12	390.00	858.00	6.00	13.20
13/15	13–15	357.50	786.50	5.50	12.10
16/20	16–20	325.00	715.00	5.00	11.00
21/25	21–25	292.50	643.50	4.50	9.90
26/30	26–30	260.00	572.00	4.00	8.80
31/50	31–50	227.50	500.50	3.50	7.70

1 US\$=
65.00

BDT

Local market prices for *Galda* were found to vary largely by season (Table 9). The rank 1 to 4 indicates prices of *Galda* in different seasons in descending order. The average maximum price was BDT 430.50 kg⁻¹ during Ashin-Kartik (Sep. to Nov.) followed by the dry (BDT 414 kg⁻¹) and winter, pre-winter, wet season (June to September, BDT 337.50 kg⁻¹).

Table 9: Price variation in *Galda* by season in local markets

Price variation	Season (higher to lower)			
	1	2	3	4
Higher prices	September (Post-Wet) to November (Pre-Winter)	December to February (dry season)	March and April (Summer)	December (beginning of dry-winter), March (beginning of summer), May (Pre-winter), June to August (wet)
Lower prices	June to August (Wet)	December to February (dry season)	February and March (Summer)	

Conclusion and Recommendation

The study conducted to focus the marketing and financial supports for small-scale artisanal *Galda* fishery in the SME of Bangladesh. Here, credit flows are not in favor of the fisher. The highest 58.63% fishers received credits from *Dadondars*. About 9.19% fishers received credit from local money lenders. Only 7.8% and 1.3% fishers received credits from the NGOs and the banks, respectively.

The Department of Forest is the legal authority in the management of aquatic resources inside the waters of the SME of Bangladesh. The authority should care the sustainable management of small-scale fisheries to ensure a sustainable growth rate of *Galda*, and protect over exploitation. Proper and easy financial and credit supports is needed for the economic betterment of the small fishers. Proper processing and preserving services are also needed for better price and international market. Government intervention in the Marketing

channel also needed to avoid many middlemen as well as to reduce the timing gap between catch to preserve.

Acknowledgement

We are thankful to the The Fisheries and Marine Resource Technology Discipline, Khulna University for the assistance conducting the research. We would also like to thank Professor Dr. Khandakar Anisul Hoq, Professor Dipak Kamal, Mr. Nurul Islam and Mr. Bipul Kumar Nondi for their advices and supports at various stages of the study.

References

- Aftabuzzaman, 1998. Sustainable Environment – Friendly Aqua-culture. In Centre for Policy Dialogue, *Environmental Consequences of Export Oriented Shrimp Culture in Bangladesh*, CPD Dialogue Report No. 18, Centre for Policy Dialogue, Dhaka, Bangladesh. 78.
- Ahmed, N., 2001. *Socio-Economic Aspects of Freshwater Prawn Culture Development in Bangladesh*. PhD thesis, University of Stirling, UK. 256.
- Ahmed, N., 2002. Socio-economic aspects of freshwater prawn culture development in Mymensingh, Bangladesh. International Center for Living Aquatic Resources Management (ICLARM) Report. Dhaka, Bangladesh. 118-122.
- Ahmed, N.; Ahammed, F. and Brakel, M.V., 2008. An Economic Analysis of Freshwater Prawn, *Macrobrachium rosenbergii*, Farming in Mymensingh, *Bangladesh. Journal of the World Aquaculture Society*, 39(1): 37-50.
- Alam, S., 2001. Production, accessibility and consumption patterns of aquaculture products in Bangladesh. In: FAO, 2001. Production, accessibility, marketing and consumption patterns of freshwater aquaculture products in Asia: a cross-country comparison. Rome: Food and Agriculture Organization of the United Nations; 2001. 154-157.
- Alam, S.M.N.; Pokrant, B.; Yakupitiyage, A. and Phillips, M.J., 2007. Economic returns of disease-affected extensive shrimp farming in southwest Bangladesh, *Aquacult Int*. 15:363–370.
- Barkat, A. and Roy, P.R., 2001. *Marine and Coastal Tenure/Community-based Property Rights in Bangladesh: An overview of resources, and legal and policy developments*. Prepared for presentation at the Marine and Coastal Resources and Community-based Property Rights: A Philippine Workshop Organized by Tambuyog Development Centre Tanggol Kalikasan, Centre for International Environmental Law and the CBCRM Resource Centre. 78-82.
- BBS, 1999. Population Census 1991, *Volume 4*, Socio-economic and Demographic Report. Dhaka.
- BBS, 2005. “Statistical Yearbook of Bangladesh; 2005”, Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People’s Republic of Bangladesh, Dhaka, Bangladesh.
- BCAS, 2001. *The costs and benefits of bagda shrimp farming in Bangladesh – an economic, financial and livelihoods assessment*. Prepared as part of the Fourth Fisheries Project by Bangladesh Centre for Advanced Studies. August 2001.
- Bhattacharya, D.; Rahman, M. and Khatun, F.A., 1999a. Environmental Impact of Trade Liberalization and Policies for the Sustainable Management of Natural Resources: A Case Study on Bangladesh’s Shrimp Farming Industry, Centre for Policy Dialogue (CPD), Dhaka, Bangladesh.

- Bhattacharya, D.; Rahman, M. and Khatun, F.A., 1999b. Environmental Impact of Structural Adjustment Policies: The Case of Export Oriented Shrimp Culture in Bangladesh. (CPD), Dhaka, Bangladesh.
- Bostock, T.; Greenhalgh, P. and Kleih, U., 2004. Policy Research – Implications of Liberalization of fish Trade for Developing Countries – Synthesis Report. Chatham, UK: Natural Resources Institute. ISBN 0 85954 560-1.
- CDSP-II, 2000. Baseline Survey of Coastal Chars in CDSP Areas 1999-2000. *Volume VIII*. RDC, 2001, Dhaka.
- Chaudhuri, A.B. and Choudhury, A., 1994. Mangroves of the Sundarbans. *Vol. I*, India. IUCN, Bangkok, Thailand.
- CODEC., 1994. Comprehensive Study on Fish Vendors in Chittagong City, Phase II; Community Development Centre, Chittagong.
- Coulter, J.P. and Disney, J.G., 1987. “The Handling, Processing and Marketing of Fish in Bangladesh” ODNRI (Overseas Development Natural Resources Institute) Bulletin No. 1, London, UK.
- Dastidar, R., 2001. Literature Review on Fish Distribution from Coastal Communities – Market and Credit Access Issues; Paper prepared for workshop on “Poverty Alleviation and Livelihood Security among the Coastal Fishing Communities – Market and Credit Access Issues”, 27-28 March 2001, Chittagong.
- DoF (Department of Fisheries), 2005. Fish Catch Statistics of Bangladesh, Bangladesh Fishery Resources Survey System. BFRSS, Department of Fisheries, Dhaka, Bangladesh.
- DoF (Department of Fisheries), 2006. Fish Catch Statistics of Bangladesh, Bangladesh Fishery Resources Survey System. BFRSS, Department of Fisheries, Dhaka, Bangladesh.
- DoF (Department of Fisheries), 2008a. Fish Catch Statistics of Bangladesh, Bangladesh Fishery Resources Survey System. BFRSS, Department of Fisheries, Dhaka, Bangladesh.
- DoF (Department of Fisheries), 2008b. Fishery Statistical Yearbook of Bangladesh 2006-2007. Fisheries Resources Service System, Department of Fisheries (DOF), Ministry of Fisheries and Livestock, Dhaka, Bangladesh, 42.
- FAO, 2004. Report of the Expert Consultation on the Role of Small-scale Fisheries in Poverty Alleviation and Food Security. FAO Fisheries Report. No. 749, Rome, 20 p.
- Gain, P., 1998. *Bangladesh Environment: Facing the 21st Century*.
- Giasuddin, M.K. (Ed), 2002. Review of the current knowledge on coastal shrimp fry collection and its impact on biodiversity. Fourth Fisheries Project *report -2002 on PL Fishery Management Action Plan*, Department of Fisheries, Ministry of Fisheries & Livestock, Dhaka, Bangladesh, , supported by Global Environment Facility/World Bank under Aquatic Resources Development, Management and Conservation Studies
- Giri, C. and Shrestha, S., 1996. Land cover mapping and monitoring from NOAA AVHRR data in Bangladesh. *International Journal of Remote Sensing*, 17 (14): 2749–2759.
- Grameen Bank, 2001. Annual Report 2001. Dhaka.
- Guha, Bakshi, D.N., Sanyal, P. and Naskar, K.R. (Eds.), 1999. Sundarbans Mangal. Naya Prokash, Calcutta, 771 pp.
- Halim, S.; Hoq, M.E.; Kamal, M. and Wahab, M.A., 2001. *Feasibility study for the shrimp component of the Fourth Fisheries Project: Women and children study*. Prepared by Bangladesh Centre for Advanced Studies, Dhaka, July 2001.
- Hannan, M., 1996. Rural credit: An Assessment of Sources and Types available in Bangladesh. Information Bulletin 11, DFID/BOBP, Chennai, India, 62 pp.

- Hill, B.J., 1984. Aquaculture of the mudcrab. In: The Potential for Aquaculture in Queensland, Queensland Department of Primary Industries Publication, 29–45.
- Hinrichsen, D., 1998. *Coastal Waters of the World: Trends, Threats and Strategies*. Island Press, USA.
- Huda, F.A.; Salehin, M.M. and Khan, M.I., 2002. Economics of Periphyton-Based Aquaculture Production in Bangladesh. *On Line Journal of Biological Sciences*, 2 (8): 518-519.
- Hussain, M. Muzaffar and Uddin, M.H., 1995. Quality Control and Marketing of Fish and Fish Products: Needs for Infrastructure and Legal Support. Paper presented at the National Workshop on Fisheries Resources Development and Management in Bangladesh, Dhaka 29 October – 1 November 1995. MoFL in collaboration with BOBP/FAO and ODA.
- Hussain, Z. and Acharya, G. (Eds.), 1994. Mangroves of the Sundarbans. *Volume 2: Bangladesh*. World Conservation Union, Gland, 257 p.
- Islam, M., 2002. Utilization of Renewable Energies in Bangladesh. Electronic Book -2. Dhaka: Shakti: Energy website of Bangladesh (URL: <http://shakti.hypermart.net>).
- Islam, M.N. (Ed.), 2007. Annual Report, 2005-2006. Department of Fisheries, Ministry of Fisheries & Livestock, Dhaka, Bangladesh, pp. 32-34.
- Islam, M.S. and Wahab, M.A., 2005. A review on the present status and management of mangrove wetland habitat resources in Bangladesh with emphasis on mangrove fisheries and aquaculture. *Hydrobiologia*, 542: 165-190.
- Ito, S., 2002. From rice to prawns: economic transformation and agrarian structure in rural Bangladesh. *The Journal of Peasant Studies*, 29(2): 47–70.
- Karim, A., 1994. Vegetation. Mangroves of the Sundarbans, Vol. 2: Bangladesh (eds. Hussain Z and Acharya G), pp. 43-74. IUCN, Bangkok, Thailand.
- Leung, P. and Sharma, K.R. (Eds.). 2001: Economics and Management of Shrimp and Carp Farming in Asia: A collection of Research Papers based on the ADB/NACA Farm Performance Survey, Network of Aquaculture Centres in Asia-Pacific (NACA), Bangkok, Thailand.
- Ling, B.H.; Leung, P.S. and Shang, Y.C., 2001. Comparing Asian Shrimp Farming the Domestic Resource Cost (DRC) Approach. In Leung P.S. and Sharma K.K. (Eds.), Economic and Management of Shrimp and Carp Farming in Asia, Network of Aquaculture Centers in Asia Pacific, Bangkok, Thailand.
- Ling, B-H, Leung, P.S. and Shang, Y.C., 1999. Comparing Asian shrimp farming: the domestic resource cost approach. *Aquaculture*, 175: 31–48.
- Manju., 1996; Nijera Kori, 1996; cited in/summarised by UNEP. 1999. *Environmental Impacts of Trade Liberalization and Policies for the Sustainable Management of Natural Resources: A Case Study on Bangladesh's Shrimp Farming Industry*. United Nations Environment Programme, New York and Geneva, 1999.
- Naskar, K.R. and Guhabakshi, D.N., 1987. Mangrove Swamps of the Sundarbans – An Ecological Perspective. Naya Prokash, Calcutta, 263 p.
- PDO-ICZMP, 2003b. Coastal Livelihoods-situation and context, Working Paper WP015, Dhaka, Bangladesh.
- Primavera, J.H., 1995. Mangroves and brackishwater pond culture in the Philippines. *Hydrobiologia*, 295: 303-309.
- Primavera, J.H., 1997. Socio-economic impacts of shrimp culture in Aquaculture Research. Vol. 28, pp. 815-827. South-East Asian Fisheries Development Centre, Iloilo, Philippines.
- Quddus, A.H.G.; Rutherford, S. and Phillips, M., 2001. *Final Report on Livelihood Analysis under Shrimp Sector. Social Feasibility Studies of the Fourth Fisheries Project*.

- Rahman, A.K.A., 1993. Marine small scale fisheries in Bangladesh. Regional Office for Asia and the Pacific, Bangkok, 55 pp.
- Rahman, M.M.; Chowdhury, Z.A. and Sada, M.N.U., 2003. Coastal resources management, policy and planning in Bangladesh, pp. 689-756. *In: G. Silvestre, L. Garces, I. Stobutzki, M. Ahmed, R.A. Valmonte-Santos, C. Luna, L. Lachica-Aliño, P. Munro, V. Christensen and D. Pauly (Eds.) Assessment, Management and Future Directions for Coastal Fisheries in Asian Countries. WorldFish Center Conference Proceeding, 67: 1-120.*
- Rollet, B., 1981. *Bibliography on Mangrove Research 1600-1975*. UNESCO, Paris, 479 pp.
- Ronnback, P., 1999. The Ecological Basis for Economic Value of Seafood Production Supported by Mangrove Ecosystems. *Ecological Economics*, 29: 235-252.
- Ronnback, P., 2001. Shrimp Aquaculture - State of the Art. Swedish EIA Centre, Report 1. Swedish University of Agricultural Sciences (SLU), Uppsala.
- Rouf, M.A. and Jensen, K.R., 2001. Coastal Fisheries management and Community Livelihood. Possible Strategy for the Sundarbans, Bangladesh, ITCZM Monograph No. 04, Series 2001.
- Rutherford, S., 1994. *CARE and Gher: Financing the Small Fry*. Report prepared for CARE International in Bangladesh with support from the Bangladesh Aquaculture and Fisheries Resource Unit (BAFRU).
- Seidensticker, J. and Hai, M.A., 1983. The Sundarbans wildlife management plan: conservation in the Bangladesh coastal zone. International Union for the Conservation of Nature and Natural Resources, Gland, 120 pp.
- Shah, W.A.; Phillips, M.; Kamal, S.; Jahan, I. and Sarker, J., 2000. The Economics of Bagda Shrimp (*Penaeus Monodon*) Farming in Coastal Areas of Bangladesh. *In: Sen S (Ed.), Grassroots Voice Volume-III, (Issues I & II), Bangladesh Resource Centre for Indigenous Knowledge, Dhaka, Bangladesh.*
- Shang, Y.C.; Leung, P.S. and Ling, B.H., 2001. Comparative Economics of Shrimp Farming in Asia. *In: Leung P.S. and Sharma K.K. (Eds.), Economic and Management of Shrimp and Carp Farming in Asia. Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand.*
- Thomas, M.A.; Macfadyen, G. and Chowdhury, S., 2001. The costs and Benefits of Bagda Shrimp Farming in Bangladesh. Bangladesh Centre for Advanced Studies, Dhaka, Bangladesh.
- Tsai, C-F, Ali, M.Y., 1997. Open-water fisheries of Bangladesh. Dhaka: University Press, 212 pp.
- Ulrich, K.; Alam, K.; Dastidar, R.; Dutta, U., Oudwater, N. and Ward, A., 2003. Livelihoods in coastal fishing communities, and the marine fish marketing system of Bangladesh. Report of Project "Fish Distribution from Coastal Communities –Market and Credit Access Issues" Project A1004, NRI Report No. 2712.
- UNEP, 1999. *Environmental Impacts of Trade Liberalization and Policies for the Sustainable Management of Natural Resources: A Case Study on Bangladesh's Shrimp Farming Industry*. United Nations Environment Programme, New York and Geneva.
- Vannuccini, S., 1999. *The Bangladeshi Shrimp Industry*. URL: <http://www.fao.org/fi/globe/blogfish/fishery/globefi/doc/presenta/bangla>.
- Viju, I.C. 1995. Issues in the management of the environment and natural resources in Bangladesh. *Journal of Environmental Management*, 45 (4): 319-332.
- WB, 2006 (World Bank). Bangladesh Fisheries Sector Review. Document of the World Bank, FAP 12/13 project, Report No. 8830-bd.
- Willams, D., 2003. Freshwater prawn farming in Bangladesh. *Fish Farmer*, 26(5): 24-27.

Zafar, M. and Ahsan. M.N., 2006. Marketing and Value Chain Analysis of Mud Crab (*Scylla sp.*) in the Coastal Communities of Bangladesh, *Research Project Final Report*, funded by AFGRP, DFID and BFRF, Dhaka, Bangladesh, pp. 30-61.